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BULLETIN No. 52

BUREAU OF EDUCATIONAL RESEARCH
COLLEGE OF EDUCATION

PREDICTING THE SCHOLASTIC SUCCESS OF COLLEGE STUDENTS

By

CHARLES W. ODELL
Assistant Director, Bureau of Educational Research

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PREFACE

In studying the progress of students through our educational system it is highly important to extend the investigation over as long a period as possible. As the author points out in the introductory chapter, this bulletin is the final report on a study of a group of several thousand high-school seniors in Illinois who have been followed through college or until they discontinued their collegiate training. Hence the collection of data extended over a period of five years. Dr. Odell deserves special commendation for continuing the investigation for so long a period in spite of the difficulties that inevitably handicap one in such a project.

The conclusions presented in this report as well as those given in the three earlier reports should be of interest to those who are called upon to advise high-school graduates with reference to attending college and to those who advise college students. Although it appears that prediction on the basis of the data considered in the present study involves large errors, it is only by ascertaining the accuracy of the predictions that may be made on various bases that we can learn how to predict more accurately. The Bureau of Educational Research is glad to present this final report of an extended study as a contribution in the field of educational guidance.

WALTER S. MONROE, Director

July, 1930.

PREDICTING THE SCHOLASTIC SUCCESS OF COLLEGE STUDENTS

CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

The recent increase in college enrollment and two resulting problems.[1] Many persons, among whom the present writer[2] is one, have called attention to the fact that among the noteworthy recent educational trends in this country has been the marked increase in enrollment, especially in that of secondary and higher schools. Although the rate of increase has not been so great for the past two or three years as it was for the period immediately preceding this time, nevertheless it is still sufficient to possess decided significance. This is shown by the figures given in the last "Statistical Survey of Education"[3] issued by the United States Office of Education, which shows that at present approximately 1 per cent of our whole population is enrolled in higher institutions, whereas shortly before the close of the last century only about one-fourth of 1 per cent was so enrolled.

This rapid increase in enrollment has been accompanied by a decline in the purchasing power of the dollar and a general demand that the scope of education be enlarged. As a result of the combined effect of these three factors, it has become very difficult to secure the amounts of money necessary to provide adequate educational facilities for all those who wish to avail themselves of them. The difficulty of doing so is probably greater in the field of higher education than in any other.

At least two outstanding problems or questions have arisen in connection with the situation just mentioned. One is that of whether or not higher institutions shall admit practically all persons who have completed secondary work and wish to enter. Most state-supported institutions have done so with little or no restriction, whereas most of those deriving their support from other sources have exercised varying degrees of selection among applicants for admission. In most cases

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[1]The discussion in this section is practically the same as that found in the corresponding portion of
Odell, C. W. "Predicting the Scholastic Success of College Freshmen," *University of Illinois Bulletin*, Vol. 25, No. 2, Bureau of Educational Research Bulletin No. 37. Urbana: University of Illinois, 1927. 54 p.

[2]Odell, C. W. "Are College Students a Select Group?" *University of Illinois Bulletin*, Vol. 24, No. 36, Bureau of Educational Research Bulletin No. 34. Urbana: University of Illinois, 1927. 45 p.

[3]Phillips, F. M. "Statistical Survey of Education, 1925-1926," *U. S. Bureau of Education Bulletin*, 1928, No. 12. Washington: Government Printing Office, 1928. 13 p.

the policies adopted have not been based upon thoroughgoing studies of the problem, and in no case upon conclusive evidence as to what is best; therefore, what should be done is still an open question. The data available[4] seem to justify the conclusion that those who now enter college constitute a marked selection of all who graduate from high school, but that among them are many individuals who are, apparently, unable to carry the usual type of college[5] work successfully. Therefore it seems desirable, perhaps even necessary, that if colleges are to continue to maintain their present standards of scholarship, they must exercise some degree of selection among those who wish to enter. From this assumption there follows the question as to what is the most satisfactory basis for making this selection. Do any data that are available or may be obtained concerning high-school graduates provide satisfactory, or even helpful, means of predicting success, especially scholarship in college? If so, which of these data have most value for this purpose, and how reliable are they?

The second question referred to is that of providing for college students of different aptitudes and abilities. If there is not considerable selection at the time of entering college, many of those admitted will fail to do satisfactory work in certain subjects, whereas in other subjects they will do at least passing, and perhaps even better, work. It is, therefore, desirable that educational guidance be provided for such students. This requires that, in so far as it is possible, colleges determine the subjects or courses in which students are most likely to succeed and those in which they are most liable to fail. Even if entrance requirements are highly selective and many applicants for admission are refused entrance, there is still a place for educational guidance, although the necessity for it is less acute. Furthermore, there has recently been much interest in the matter of providing different types or levels of instruction within the same subject and in other ways adapting the educational opportunities offered to the individual differences of students. This has been much more prominent in elementary and high schools than in colleges, but within the past few years a considerable number of the latter have been devoting serious attention to the problem. In this case, also, the less selective is college admission, the greater is the need to provide for differences among students. Even when admission is highly selective, however, those allowed to enter do not constitute truly homogeneous groups, so that there is still need for seeking satisfactory bases of classifying them and of adapting subject-matter to differences in ability, aptitude, and so forth.

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[4]Odell, *op. cit.*, p. 26-29.

[5]The term "college" will be used in a general sense to include all types of institutions of higher learning.

The purpose of this bulletin. It is the purpose of this bulletin to present what will probably be the final report of a study and evaluation of some of the more easily available items of information which probably are of value in foretelling scholastic success in higher institutions. This bulletin is the fourth of the series concerned with this study. The first[6] presented data having to do with the individuals dealt with by the study while they were still in high school. The second[7] reported some data bearing upon the question of the selection of college entrants from all high-school graduates. The third[8] gave the results of comparing freshman college records with the various items of information collected before college entrance. The present one continues the study throughout four years of college work, or as great a portion of these four years as the individuals concerned remained in college or could be followed. The writer has attempted to determine not only bases of prediction for college success in general, but also for each subject carried by any considerable number of the college students included. The purpose of this bulletin may, therefore, be stated as being to present data which show the accuracy of high-school marks, intelligence test scores, and other data in predicting the persistence in school and the marks of college students. Furthermore, the same problem will be dealt with from the standpoint of predicting success in the last three years of college upon the basis of freshman college marks in addition to the other predictive data mentioned above. The problem will be attacked primarily by the methods of simple and multiple correlation, and the accuracy of predictions based upon the best multiple regression equations will be shown.

This bulletin will not devote any attention to the numerous studies of others who have been attacking the same problem as the present writer. There are at least three reasons for not doing so. One is that what seemed to the writer the outstanding studies of this type were briefly summarized in connection with the report of this study that dealt with the prediction of success of college freshmen.[9] The second reason is that others[10] have prepared such satisfactory summaries of what has been done in this field that an additional one does not seem

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[6]Odell, C. W. "Conservation of Intelligence in Illinois High Schools," *University of Illinois Bulletin*, Vol. 22, No. 25, Bureau of Educational Research Bulletin No. 22. Urbana: University of Illinois, 1925. 55 p.

[7]Odell, C. W. "Are College Students a Select Group?" *University of Illinois Bulletin*, Vol. 24, No. 36, Bureau of Educational Research Bulletin No. 34. Urbana: University of Illinois, 1927. 45 p.

[8]Odell, C. W. "Predicting the Scholastic Success of College Freshmen," *University of Illinois Bulletin*, Vol. 25, No. 2, Bureau of Educational Research Bulletin No. 37. Urbana: University of Illinois, 1927. 54 p.

[9]Odell, *op. cit.*

[10]For one of the most recent summaries, *see*:
Woody, Clifford (Chairman). "Quantitative Measurement in Institutions of Higher Learning," *Eighteenth Yearbook of the National Society of College Teachers of Education*. Chicago: University of Chicago Press, 1930, Chapters III and IV.

to be needed. Finally, the results to be presented later in this bulletin are so similar in general trend to those obtained from many of the other studies that reporting the results of the latter would be largely unnecessary repetition.

CHAPTER II

THE GENERAL PLAN OF THIS STUDY

The initial collection of high-school data. The data used in this investigation concern a group of individuals graduated from several hundred high schools in the state of Illinois in 1924 and admitted to various institutions of higher learning in the summer or autumn of the same year. In the fall of 1923 all the four-year public high schools in the state were invited to cooperate with the Bureau of Educational Research in this study. The number that did so was 368, a few more than one-half of all those within the state, and the number of seniors included was about 12,300. The data secured concerning them consisted of their scores upon the Otis Self-Administering Test of Mental Ability, Higher Examination, Form A and the answers to the questions on an "Information Blank for High-School Seniors," which called for the following information:

Name
Sex
Date of Birth
Age on September 1, 1923
Name of School
Town or city
Intentions concerning further education
  Intention of continuing
  Institution
  Course
  Major subject
Vocational choice
Father's occupation
Information as to previous intelligence tests taken
Units of high-school credit
High-school subjects liked most
High-school subjects liked least
Number of failures in high school
Average high-school mark[1]

The tests were given by principals or by teachers designated by them and the information blanks filled out by the seniors themselves. All scoring of test papers and tabulation of results was done in the offices of the Bureau of Educational Research.

The second step in collecting high-school data. A year later, in the fall of 1924, the 368 high schools were asked to furnish the complete high-school scholastic records of all pupils for whom the other information had been secured, and also, if possible, to state what, if

[1]This was the average mark up to date or for the first three years. It was secured from only a minority of the schools and for about 2700 seniors.

any, institution of higher learning each individual was attending. A few of the seniors of the year before had not been graduated, and in a few cases the desired records were not forthcoming, but the loss from these sources was comparatively small, so that the complete scholastic high-school records of about 11,500 graduates were secured. Since these marks came from several hundred schools which employed a total of over one hundred different marking systems, if all minor variations be counted, it was necessary to transmute them to a uniform basis. For this purpose a percentile system with passing at 70 and no conditions was chosen. The marks given according to all other plans were changed to this system by conventional and careful statistical procedure.

The collection of college freshman data. Some three hundred institutions of higher learning had been named by the seniors in answer to the question as to where they expected to continue their education. Early in the academic year of 1925-26 letters were addressed to all these institutions asking for the complete 1924-25 scholastic records of all freshmen coming from any of the high schools included in this study. About 7,700 of the seniors had stated that they intended to continue their education, in addition to many who were undecided, and the majority of them had named the institutions they expected to attend. Despite this fact the freshman records of not quite two thousand students were all that were secured. This loss is due to at least four causes. In the first place, a number of the colleges addressed either were unwilling to cooperate in the study, or, after expressing their willingness to do so, failed to send the desired records. A second reason was that a number of the institutions which did cooperate failed to furnish the data for all of their students for whom they were desired. Third, undoubtedly many of the high-school graduates who planned to attend college found it necessary, for financial or other reasons, to postpone entrance for a year or more after high-school graduation. The last, and probably the most important, reason was the fact that in filling out the information blanks the high-school seniors expressed their highest hopes and ambitions or gave answers which they thought would sound best and that, therefore, many of them who had very slight expectations of ever actually attending college, signified that they intended to do so.

Of the approximately two thousand students whose records were secured from various colleges, almost one hundred did not remain in college long enough to have any marks recorded. The number for whom marks for at least one quarter, term, or semester were secured

was 1,892, and for 1,677 of these a full year's marks were obtained. As these marks were given by more than one hundred institutions it was necessary to transmute them to a common basis in the same manner as had been done for the high-school marks, and so all were adjusted to the same basis of a percentile marking system with 70 as passing and no conditions.

The collection of complete college data. If the individuals whose college freshman records were secured had continued in residence and earned the normal amount of credit, they would have been graduated in the spring of 1928. Therefore early in the autumn of 1928 the writer attempted to secure the complete college scholastic records of all those for whom college freshman data had been collected. The response from the institutions addressed was so very generous that practically none of those concerned were not followed up except a few who appear to have transferred from one institution to another and could not be located. Four hundred and eighty-six of those concerned were graduated at the end of the four-year or normal period. In addition to these about one hundred others were still in attendance at the end of four years. The remainder, about thirteen hundred, had, in so far as was known, dropped out of college at some time before the completion of the four-year period and had not returned. After the data for the whole college course had been collected, they were subjected to the same procedures as those for the freshman year.

The reliability[2] of the data secured in this investigation. There is no doubt that in both intelligence test scores and high-school and college marks large variable errors are present. No group intelligence test so far devised yields highly accurate individual scores, and the Otis Self-Administering Test, which requires only half an hour to give, is probably less reliable than one, such as the Thorndike Intelligence Examination, which consumes two or three hours. Moreover, the tests were not administered by a corps of trained and selected examiners, but by several hundred different principals and teachers, many of whom had probably never before given a standardized test. This fact undoubtedly served to increase the errors in the scores. It should not be overlooked, however, that the test used reduces the directions to be given by examiners to a minimum and that, therefore, the errors due to lack of training of the persons giving the tests are less than would otherwise be the case. The writer does not believe, however,

[2]As used in this bulletin, the term "reliability" is practically equivalent to "accuracy." It is not limited to its sometime narrow technical meaning referring to the agreement between two sets of scores on the same measuring instrument, although it includes this.

that this factor of added reliability is sufficient to balance the two of brevity and administration by poorly qualified examiners.

Another fact which probably affected the significance of the test scores was that about half of the seniors tested had never taken an intelligence test before and it is likely that many of their scores, when compared with those of the seniors who had taken such tests previously, do not fairly represent their mental ability. Furthermore, because of the conditions under which the tests were given, there was generally no particular incentive, apart from the desire to excel, for the seniors to do their best. Hence, it is likely that a considerable number of them did not put forth maximum effort while taking the test. These and all other causes which produce variable or accidental errors in the test scores result in lowering the correlations and other predictive indices based thereon and justify the conclusion that the real relationships are somewhat closer than those actually computed.

Too much evidence and discussion concerning the subjectivity and unreliability of school marks has appeared within the last few years for the subject to need extended comment in this connection. Undoubtedly the errors present in the marks were increased somewhat by the fact that marks from several hundred high schools and more than a hundred colleges with different systems and standards were transmuted to a common basis and thrown into a single group. In spite of the fact that the transmutation was made with great care and followed sound statistical procedure, it was not possible, in all cases, to be sure that the transmuted marks were really equivalent to the original ones. The effect of increasing such variable errors was to lower the coefficients of correlation and other predictive measures secured.

The computation of zero-order coefficients of correlation. As was previously stated, the chief method employed to determine the relationship between college marks and other data available was that of correlation. In the case of each of more than fifty college subjects or closely related groups of subjects[3] simple or zero-order coefficients of correlation were computed between the marks therein, and those of the other data that seemed most likely to have predictive value. In all cases the college marks were correlated with intelligence test scores and general high-school averages, and in the case of each subject with the marks in those high-school subjects or groups of subjects that seemed most likely to show the closest relationships. The correlations

[3]In a number of cases it is doubtful just what really constitutes a "subject" as the term is commonly used. This, for example, is true of agriculture. In cases in which there were only a few freshmen who carried each of the several possible divisions the procedure followed was to group them together as a single subject. Agriculture, therefore, includes various courses in agronomy, animal husbandry, and so forth; art includes freehand drawing, painting and sculpture, and so on with others.

previously obtained in the study of freshman college marks were used as a guide in determining those which it seemed most profitable to compute in this study. All college subjects or groups of subjects which were carried by enough students that the resulting data would be fairly reliable were dealt with in this manner.

The computation of coefficients of multiple correlation and regression. The calculation of zero order or simple coefficients of correlation was followed by that of multiple coefficients. In view of the considerable amount of labor involved in computing the latter they were not found for all college subjects, but for only about 40 percent of them. These were in general the subjects carried by the largest numbers of students and those for which the simple correlations were highest. In connection with this the admission should be made that since many possible correlations were not computed, it is probable that some were omitted which should have been found. Since the amount of money available for clerical help, although fairly large, was not unlimited, it was necessary that the line be drawn somewhere, and it is very likely that the writer's judgment in selecting the most promising possibilities was not infallible. In the case of several of the college subjects two or three groupings were made according to the high-school subjects carried and a different set of multiple correlations computed for each grouping. For example, in addition to calculating the correlations and regressions for all students who carried French as a college subject, they were also found separately for the portion of this group that had carried high-school French and also for that which had taken high-school Latin. Also in the cases of a few college subjects separate correlations were computed according to the number of hours of work therein carried by different groups of students. The most common basis was to put into one group students who had carried less than ten hours and into another those who had carried ten or more. Sometimes the latter group was divided into two, one of which contained those who had carried from ten to nineteen hours inclusive, and the other, those who had carried twenty or more.

The general procedure in computing the multiple coefficients was to start with the highest one of zero order and combine the others of the same order with it until the addition of another criterion no longer increased the obtained coefficient by as much as .01. Because of the fact referred to above, that many of the simple coefficients of correlation were really multiple in nature though not in derivation, it could not be expected that on the whole there would be as great an increase in the multiple coefficients over those of zero order as would otherwise have been the case.

The question may be raised as to why certain combinations, which will appear later in the chapter containing the multiple correlation results, were made, in view of the fact that one of the simple correlations already used was that of the freshman mark with the general high-school average or the average in a group of similar subjects, and another the correlation with one of the subjects which entered into this group. The reason for so doing is, however, clear to any one familiar with multiple correlation. In computing the high-school general average or the average in any group of similar subjects the marks entering into the given average were all allowed the same weight in determining it. By means of multiple regression equations, however, one is able to determine the optimum weight which should be given to each factor, that is, the weight to give it so that the highest correlation or predictive power will be obtained.

The direct method of securing the same result would be to use no averages of marks in different high-school subjects, but to consider each as a separate variable or criterion in the multiple correlation work. The reason this was not done was that it would have increased very greatly the amount of calculation necessary without yielding more helpful results than the method used. It would, of course, have shown exactly just which of the subjects entering into the high-school average were useful for making the best prediction in each case and which were not, but there seems little advantage in knowing this, provided one knows how to make as good an estimate without this knowledge and with even less labor. Not only was much work saved in computation, but also in the use of results, since the multiple coefficients secured involve, on the whole, fewer variables or criteria than would be the case if averages of high-school subjects had not been taken and therefore require less computation in employing them for predictive purposes. The objection can be raised that there are included in the general high-school average marks made in subjects which show much lower correlations with the freshman subject being considered than do those of certain other high-school subjects and that the inclusion of these marks may have lowered the correlation between the freshman subject marks and the high-school average. This contention is true, but the writer believes that for all practical purposes any such results have been taken care of by including in the multiple correlations the subjects which appeared at all likely to make any contribution to them. Thus, for example, if freshman French mark was best predicted by a combination of high-school marks in English, French and Latin and point score, rather than by including the general high-school average, the method of computation used eliminated the latter. In any

event, in view of the practical limitations of time and money, it seemed advisable, if not absolutely necessary, to follow the method described above.

Minor methods of prediction employed. In addition to the method of correlation a few minor methods were employed and will be presented later. By these means will be shown the relationship between college success and size of high school attended, occupational intentions, fathers' occupations, and so forth. Since most of these involve one factor that cannot well be expressed in numerical classes and, therefore, does not lend itself to the computation of coefficients of correlation,[4] the method of summarizing such data will ordinarily be by means or medians.

The measures of accuracy of prediction obtained in this study. Finally, as a measure of the accuracy or reliability of predictions based upon coefficients of correlation, the corresponding coefficients of alienation and probable errors of estimate were determined. The first of these,[5] the coefficient of alienation, is an expression that shows the relationship between the prediction based upon a given coefficient of correlation and a pure guess. For example, the coefficient of alienation which corresponds to a correlation coefficient of .65 is approximately .76. This means that if two variables or series of scores correlate .65 with each other, the estimates of particular scores in one series based upon corresponding known scores in the other will on the average be in error by about .76 as much as if the errors resulted from pure guesses, or, subtracting .76 from 1.00, that the errors will be .24 smaller than those in pure guesses.

The probable error of estimate describes the same situation by stating the limits within which half of the errors will fall. For example, if the probable error of estimate is found to be 4 points on the percentile scale, it means that half of the estimated scores will not vary from the true scores by more than 4 per cent, and, of course, that the other half will differ by more than this amount. These two indices, the coefficient of alienation and the probable error of measurement, give a more concrete and meaningful description of the accuracy of prediction than does the coefficient of correlation.

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[4]As may be seen by reference to textbooks in statistics, there are methods for computing correlation of non-numerical data, but since they are not familiar to most readers of this bulletin, and since it does not appear to the writer that they provide more significant interpretations of the data than does the use of medians, they will not be employed herein.

[5]For a more complete discussion of the coefficient of alienation and the probable error of estimate, *see* Chater VI. Also:

Odell, C. W. "The Interpretation of the Probable Error and the Coefficient of Correlation," *University of Illinois Bulletin*, Vol. 23, No. 52, Bureau of Educational Research Bulletin No. 32. Urbana: University of Illinois, 1926, p. 28-32 and 41-45, and

Odell, C. W. *Educational Statistics*. New York: Century Company, 1925, p. 173-74, 230-41, or some other text on the same subject.

CHAPTER III

THE PREDICTION OF COLLEGE MARKS FROM THE DATA AVAILABLE AT COLLEGE ENTRANCE

The simple correlations between college marks and the other data. In Table I the simple or zero-order coefficients of correlation between college marks and the data available in this study at the time of college entrance are given. The college marks used were those in fifty-five subjects or closely related groups of subjects for the whole number of hours thereof carried by the individuals included in the study. The fifty-five include all subjects or groups of subjects which were pursued by enough students that they seemed worth dealing with, especially from the standpoint of the reliability of the results. In the column headed "Point Score" are the coefficients of correlations between the college marks just mentioned and the point scores on the intelligence test given when the students were high-school seniors. In the next column are the correlations between college marks and high-school averages. To the right of this column are the correlations between the college marks and those in the high-school subjects or groups of subjects that seemed most likely to have the closest relationships with them. These were chosen largely on the basis of the results obtained for freshman college marks and published in the report of that study.[1] Thus the first row of the table, for example, shows that marks in college accountancy correlated .20 with point scores, .45 with high-school averages, .29 with average marks in all high-school commercial work, and .47 with those in all high-school mathematics. In some cases there were no high-school subjects or groups of subjects that appeared sufficiently similar to the college subjects dealt with that it seemed worth while to correlate the marks therein. As is stated by the first note at the bottom of the table, those coefficients enclosed in parentheses are not reliable since they are not equal to more than twice their standard errors or three times their probable errors. The chances are greater than twenty-one or twenty-two to one that all of the coefficients not enclosed in parentheses are significant, and for most of them the chances are very much greater than this.

If the figures given in this table for complete college marks are compared with the corresponding ones for college freshman marks as previously reported,[2] it will be seen that on the whole there is very

[1] Hoyt, C. W., "Predicting the Scholastic Success of College Freshmen," University of Illinois Bulletin, Vol. 25, No. 2, Bureau of Educational Research Bulletin No. 37. Urbana: University of Illinois, 1927, Table III, opposite p. 28.

TABLE I.—COEFFICIENTS OF CORRELATION OF COLLEGE MARKS WITH POINT SCORES AND HIGH-SCHOOL MARKS

College Subject	Point Score	High-School Average	High-School Subjects and Groups of Subjects
Accountancy	.29	.45	Comm. .29, Math. .47
Agriculture	.38	.51	Agr. .56, Sci. .46
Anatomy	(.10)[a]	.45	Sci. .30
Art	.19	.26	Art .41
Astronomy	.42	.41	Math. .39
Athletic Coaching	.34	.43	
Bacteriology	(.17)	(.19)	Biol. .25
Bible	.26	.41	Eng. .40
Biology	.24	.48	Biol. .34, Gen. Sci. .37, Sci. .42
Botany	.42	.43	Biol. .48, Gen. Sci. .38, Sci. .42
Business Law	.25	.23	
Bus. Org. and Oper.	(.12)	.22	
Chemistry	.33	.41	Chem. .43, Gen. Sci. .25, Phys. .37, Sci. .39
Civics	(.18)	.31	Hist. .35
Drawing	.15	.20	
Economics	.26	.39	Civ. .32, Econ. .32, Hist. .40
Education	.28	.39	
English	.33	.45	Eng. .38
Elec. Engineering	(.00)	(.05)	Math. .10
French	.31	.52	For. Lang. .48, French .50, Lat. .47, Span. .43
Gen. Engin. Drawing	.30	.23	Math. .29, Free Dr. .38
Geography	.38	.41	Geog. .24, Sci. .35
German	.28	.45	For. Lang. .41
Geology	.17	.40	Sci. 33
Greek	(.23)	.48	For. Lang. .49, Lat. .44
History	.25	.41	Hist. .41
Home Economics	.20	.28	
Hygiene	.14	.36	Sci. .34
Journalism	.64	.56	Eng. .56
Language	.25	.36	Eng. .31, For. Lang. .43
Latin	.25	.47	For. Lang. .34, French .41, Lat. .39
Library	.35	.48	Eng. .45
Mathematics	.23	.47	Alg. .38, Geom. .42, Math. .44
Military	(.04)	.21	
Music	.32	.35	
Nature Study	(.11)	.29	
Orientation	.42	.71	Hist. .61
Philosophy	.13	.34	Eng. .34, Hist. .33
Phonics	.37	.42	Eng. .33, For. Lang. .48
Physical Education	.18	.17	
Physics	.33	.39	Geom. .35, Math. .37, Phys. .30, Sci. .36
Physiology	.38	.39	Gen. Sci. .20, Sci. .38
Political Science	.25	.29	Civ. .34, Hist. .27
Psychology	.43	.33	Sci. .37
Public Speaking	.19	.32	Eng. .35
Reading	.30	.35	Eng. .35
Religious Education	(.10)	.36	
Rhetoric	.34	.46	Eng. .46, Lat. .39
Scandinavian	(.28)	(.31)	Eng. .41
Sociology	.27	.40	Civ. .35, Hist. .35
Spanish	.20	.52	For. Lang. .49, French .52, Lat. .46, Span. .51
Stenography	(.31)	.39	Eng. .34
Theor. and App. Mech.	(.01)	.25	Geom. .34, Math. .37
Transportation	(.16)	.37	
Zoology	.38	.48	Biol. .40, Sci. .40
College Average[b]	.31	.54	

[a]The coefficients enclosed in parentheses are not reliable. Because of the small number of cases contributing to each, they are not equal to more than twice their standard errors, or three times their probable errors. Those without parentheses are all larger than this ratio.

[b]The coefficients following "College Average" are those of the average freshman mark in all subjects, not the averages of the columns above them.

little difference. The correlation between complete college averages and point scores given here, .31, is several points lower than that between freshman averages and point scores, which was found to be .38. The correlation between complete college averages and high-school averages, .54, is almost exactly the same as that between freshman averages and high-school averages, which was found to be .55. If the coefficients of correlation of the separate college subjects with point scores, high-school averages and high-school subjects or groups of subjects are averaged, they are found to be, respectively, .26, .38, and .39. For freshman marks the corresponding figures are: .27, .38, and .38. Thus in no case is the difference greater than .01, which shows that the relationship between marks received during the whole period of attendance at college and the data available at college entrance is almost exactly the same as that between freshman college marks and the same data.

In the cases of a number of the different college subjects included in Table I, some or all of the coefficients of correlation are decidedly higher or lower than the corresponding ones for freshman marks, but in general the differences are not great. There is a strong tendency for the same subjects to have high correlations, likewise for the same ones to have low correlations. For example, agriculture, French, and Spanish are among those relatively high in both tables, and art, military work, and physical education among the low ones.

An inspection of the table shows that there are very few coefficients of .50 or above. The only college subject that correlates more than this with point score is journalism, for which the coefficient is .64. The correlations with high-school average are somewhat higher, there being five subjects which do so to the extent of .50 or above. One of these, orientation, gives a coefficient of .71, but none of the others, agriculture, French, journalism, and Spanish, rise very much above .50. General college average, it will be noted, correlates .54 with high-school average. Among the correlations between college subjects and high-school subjects, or groups of subjects, there are about half a dozen that reach .50. Agriculture correlates .56 with high-school agriculture; French, .50 with high-school French; journalism, .56 with high-school English; orientation, .61 with high-school history; Spanish, .52 with high-school French and .51 with high-school Spanish. When it is recalled that a coefficient of correlation of .50 is equivalent to a coefficient of alienation or element of uncertainty in prediction of almost .87, it will be seen that the accuracy with which college marks can be predicted by simple correlation with point scores, high-school

averages or marks in high-school subjects, is decidedly low. In the following section the accuracy of prediction when multiple correlation is employed will be discussed.

The multiple coefficients of correlation between college marks and the other data. Twenty-three of the fifty-five college subjects listed in Table I were selected for the application of multiple correlation. In general these were the subjects in which there were the largest enrollments or for which the simple correlations were the highest. In several of the subjects two groupings were made according to the number of hours of college work carried by students therein and separate results computed for those who had carried the smaller and the larger numbers of hours. Furthermore, in four subjects separate tabulations were made according to the high-school subjects carried by the individuals concerned.

Table II presents, in addition to certain other related data, the highest multiple coefficients for each of the twenty-three subjects. The first set of four columns therein is for the highest simple coefficient of correlation obtained for each of the subjects mentioned, the second group of four is for the highest multiple coefficient, and the last group of three is for the increase of the multiple over the simple coefficient. Within each of the two groups of four the first column, headed "r" and "R," contains the actual coefficients of correlation; the second, headed "k," the corresponding coefficients of alienation; the third, headed "$P.E._{est}$," the corresponding probable errors of estimate; and the fourth, the one or more criteria used in the correlations. The last three columns contain, in order, the increases in the highest multiple over the highest simple coefficients of correlation and the accompanying decreases in the coefficients of alienation and the probable errors of estimate.[3] For example, taking the first line of the table, the highest simple coefficient of correlation of the accountancy mark with any single criterion was .57, the corresponding coefficient of alienation was .82, the probable error of estimate, 5, and the criterion, high-school mathematics mark. The highest multiple correlation obtained for algebra was .58, with a coefficient of alienation of .82 and a probable error of estimate of 5. It was based on two criteria, high-school mathematics mark and point score. The increase in the coefficient of correlation was .01, whereas there was no change in the coefficient of alienation or the probable error of estimate.

[3]It should be remembered that an increase in the coefficient of correlation and decreases in the coefficient of alienation and the probable error of estimate indicate closer relationship or greater accuracy of prediction.

TABLE II.—HIGHEST SIMPLE AND MULTIPLE COEFFICIENTS OF CORRELATION BETWEEN COLLEGE MARKS AND DATA AVAILABLE AT COLLEGE ENTRANCE

College Subject	Highest simple correlation with any one criterion				Highest multiple correlation with several criteria				Increase[a] of highest multiple over highest simple correlation		
	r[b]	k	P.E.$_{est}$	Criterion[c]	R	k	P.E.$_{est}$	Criteria[c]	R-r	k	P.E.$_{est}$
Accountancy	.57	.82	5	Math.	.58	.82	5	Math., P.S.	.01	.00	0
Agriculture	.70	.71	2	Aver.	.76	.65	2	Aver., P.S', Sci., Agric.	.06	.06	0
Astronomy	.46	.89	5	P.S.	.47	.88	5	P.S., Math.	.01	.01	0
Biology (1-9)[d]	.51	.86	4	Aver.	.52	.85	4	Aver., P.S.	.01	.01	0
Biology (10+)	.56	.83	3	Sci.	.61	.79	3	Sci., P.S. Aver.	.05	.04	0
Botany	.54	.84	5	Biol. or Sci.	.69	.72	4	Biol., P.S., Sci., Aver.	.15	.12	1
Chemistry (1-19) I[e]	.42	.91	6	Aver.	.45	.89	6	Aver., P.S., Sci.	.03	.02	0
Chemistry (1-19) II	.36	.93	6	Sci.	.44	.90	6	Sci., P.S., Gen. Sci., Aver.	.08	.03	0
Chemistry (1-19) III	.44	.90	6	Chem.	.47	.88	6	Chem., P.S., Aver.	.03	.02	0
Chemistry (20+) I	.56	.83	3	Phys.	.59	.81	3	Phys., Aver.	.03	.02	0
Chemistry (20+) II	.67	.74	3	Sci.	.71	.70	3	Sci., Aver., P.S.	.04	.04	0
Chemistry (20+) III	.58	.82	3	Sci.	.60	.80	3	Sci., Chem., P.S.	.02	.02	0
Economics (1-19)	.39	.92	5	Aver.	.41	.91	5	Aver., Hist., P.S.	.02	.01	0
Economics (20+)	.54	.84	2	Aver.	62	.78	2	Aver., P.S., Hist.	.08	.06	0
Economics[f]	.39	.92	6	Aver.	.40	.92	6	Aver., Hist.	.01	.00	0
French I[g]	.55	.84	4	For. L.	.59	.81	4	For. L., P.S.	.04	.03	0
French II	.53	.85	4	Aver.	.55	84	4	Aver., P.S., For. L.	.02	.01	0
French III	.52	.85	5	For. L.	.57	82	4	For. L.	.05	03	0
German	.42	.91	6	For. L.	.44	.90	6	For. L., P.S., Aver.	02	.01	0
Greek	.44	.90	4	For. L.	.49	.87	4	For. L., Lat., Aver.	.05	.03	0
History (1-19)	.45	.90	6	Hist.	.47	.88	6	Hist., Aver., P.S.	.02	.02	0
History (20+)	.58	.82	3	Aver.	.64	.77	3	Aver., P.S., Hist.	.06	.05	0
Journalism	.59	81	4	P.S.	.65	.76	3	P.S., Eng.	.06	.05	1

TABLE II.—*(Concluded)*

College Subject	Highest simple correlation with any one criterion				Highest multiple correlation with several criteria				Increase[a] of highest multiple over highest simple correlation		
	r[b]	k	P.E.$_{est}$	Criterion[c]	R	k	P.E.$_{est}$	Criteria[c]	R-r	k	P.E.$_{est}$
Language	.41	.91	4	For. L.	.48	.88	4	For. L., P.S., Eng.	.07	.03	0
Latin (1-9)	.44	.90	6	Aver.	.46	.89	6	Aver., P.S., For. L., Lat.	.02	.01	0
Latin (10+)	.44	.90	4	For. L.	.45	.90	4	For. L., Aver., P.S.	.01	.00	0
Library Science	.49	.87	4	Aver.	.52	.85	4	Aver., P.S., Eng.	.03	.02	0
Mathematics (1-9)	.43	.90	6	Aver.	.44	.90	6	Aver., Math.	.01	.00	0
Mathematics (10+)	.52	.85	4	Math.	.52	.85	4	Math.	.00	.00	0
Orientation	.73	.68	3	Hist.	.77	.64	3	Hist., P.S., Aver	.04	.04	0
Philosophy	.37	.93	5	Eng.	.38	.92	5	Eng., Hist., Aver.	.01	.01	0
Phonics	.51	.86	4	For. L.	.56	.83	4	For. L., P.S., Eng. or Aver.	.05	.03	0
Physics	.40	.92	5	Aver.	.46	.89	4	Aver., P.S., Math. or Sci.	.06	.03	1
Rhetoric	.46	.89	4	Eng.	.52	.85	4	Eng., P.S.	.06	.04	0
Spanish I[h]	.51	.86	5	For. L.	.53	.85	5	For. L., Aver.	.02	.01	0
Spanish II	.55	.84	5	Aver.	.57	.82	5	Aver., Fr.	.02	.02	0
Spanish III	.49	.87	5	Aver.	.50	.87	5	Aver., Lat.	.01	.00	0
Spanish IV	.60	.80	5	Aver.	.62	.78	5	Aver., P.S., Span.	.02	.02	0
Zoology	.48	.88	5	P.S.	.59	.81	4	P.S., Aver., Biol.	.11	.07	1
Average	.54	.84	4	Aver.	.55	.84	4	Aver., P.S.	.01	.00	0

[a]The entries in the first column under this heading are actual increases in the coefficients of correlation and those in the other two, decreases in the coefficients of alienation and probable errors of estimate. In all cases, however, they indicate the increases in accuracy or reliability of prediction.

[b]The values of "r" given in this column are not in all cases the same as those given in Table I. This is due to the fact that those given here are the highest of the ones available for multiple correlation and in some cases do not include quite all of the cases which contribute to those in Table I.

[c]The abbreviations in these columns are of the different high-school subjects and groups of subjects, except "P.S." which is used for point score.

[d]In the cases of several subjects separate computations were made according to the numbers of hours carried in college. In such cases the numbers of hours are indicated in parentheses after the names of the subjects.

[e]Chemistry I includes students who had high-school physics, Chemistry II, those who had high-school general science, and Chemistry III, those who had high-school chemistry.

[f]This includes only those students who had high-school economics.

[g]French I includes students who had both Latin and French in high school, French II, all those who had Latin and French, and French III, all those who had French.

[h]Spanish I includes students who had any foreign language in high school, Spanish II, those who had high-school French, Spanish III, those who had high-school Latin, and Spanish IV, those who had high-school Spanish.

It will be seen from the table that only in the cases of agriculture, chemistry (20 +)II, and orientation were multiple coefficients of .70 or above obtained from the best possible combination of criteria. In just about one-fourth of all cases were the highest multiple coefficients as large as .60, whereas in more than one-third they were below .50. Most of the corresponding coefficients of alienation were between .80 and .90, although a few were smaller. The probable errors of estimate were in most cases either four or five points on the percentile scale. The smallest, those for agriculture and economics (20 +), were two. If these results are compared with those given in the report of the study of freshman college marks,[4] it will be seen that there is a slight but not very strong tendency for those found in this study to be higher. None of the coefficients of correlations for freshman marks were above .63, and, correspondingly, none of the coefficients of alienation were below .78. On the other hand, the proportion of multiple coefficients below .50 is almost the same in the one case as in the other. The conclusion to be drawn appears to be that complete college marks can probably be predicted with slightly greater accuracy than can freshman marks in a number of subjects, whereas in others there is practically no difference in the certainty of prediction.

A comparison of the multiple correlation coefficients with the simple ones given in Table II shows that the increases of the former over the latter were comparatively small. In only two cases, those of botany and zoology, were they greater than .10, and in well over half of them they were less than .05. Correspondingly the decreases in the coefficient of alienation were in only six cases as great as .05 and in more than half not greater than .02. In only four cases was the decrease in the probable error of estimate great enough to appear when whole numbers were used. The situation may be summed up by saying that the increased reliability of prediction obtained by using multiple instead of simple correlation was in very few cases sufficient to justify the additional labor and expense involved.

An inspection of the columns of Table II, in which the criteria are given, shows that, with few exceptions, the most helpful one was either the high-school average or the mark in the same or a similar high-school subject or group of subjects. For only three of the simple correlations included in the table were point scores the best criteria of prediction. On the other hand, most of the groups of criteria involved in the multiple correlations included point scores among them. Apparently, therefore, the intelligence test scores, although less valuable

[4]Odell, *op. cit.*, p. 36-37.

in prediction than high-school marks, do contribute a somewhat different element than do marks.

Relationship between college marks and vocational choices. It has sometimes been suggested that the vocational choices of college students are indicative of the quality of their college work. A tabulation was, therefore, made to show the relationship of this sort existing in the case of the students included in the study. It seems scarcely worth while to give the complete table showing this relationship, since the significant points thereof may be stated in comparatively few words. The results tend to be similar to those found by other investigators to the effect that students who have chosen vocations that require longer periods of training or, in other words, those that are generally termed professions, tend to make somewhat higher marks than do those who have made other choices. The differences found in this study, however, are comparatively small, and in the case of one or two vocational groups exceptions exist. Those who have made the following vocational choices averaged approximately 2 per cent or more above the total group: law, journalism and other publicity work, and philanthropic work. The only professional group below the average was in medicine, and this was so slightly below that the difference was not significant. The average for those who had not made vocational choices was enough below that of those who had made such choices that the difference was statistically significant. On the whole, however, there was such great overlapping shown that it can scarcely be said that in the case of any individual student the knowledge of what vocation he has chosen or, indeed, of whether he has made any such choice or not, affords significant help in predicting his average college mark.

Relationship between college marks and fathers' occupations. The results from a comparison of college marks with the occupations of the students' fathers[5] indicated that the latter had practically no connection with the former. The children of lawyers and philanthropic workers made marks far enough above the general average that the differences were significant, and those of transportation employees far enough below to be barely significant, but in the case of no other group was the difference appreciable, and even in these they were barely statistically significant. It seems, therefore, even more true of fathers' occupations than of vocational choices that they are of so little value

[5]If the students' fathers were living at the time the students filled out the question blanks, their occupations at that time were reported. If they were dead, the last occupation in which each was engaged was reported.

for predicting college marks that they are probably not worth using in individual cases.

Summary. In this chapter the simple and multiple correlations between college marks and high-school marks and point scores have been presented and also a brief statement given of the relationship between college marks and vocational choices and fathers' occupations. In general, the use of the best single criterion for predicting college marks involved a coefficient of alienation or uncertainty of prediction of from .80 to .90, and in no case was it less than .70. The situation is only slightly better when the method of multiple correlation is employed, since the smallest resulting coefficient of alienation was .64 and since only about one-fourth of the coefficients of alienation were less than .80. Occupational choices offered a little evidence as to college marks, and fathers' occupations, practically none at all.

CHAPTER IV

THE PREDICTION OF MARKS DURING THE LAST THREE YEARS OF COLLEGE FROM DATA AVAILABLE AT THE END OF THE FRESHMAN YEAR

The simple correlations between marks during the last three years and the other data. Only those simple coefficients of correlation between the marks received by college students during their last three years and the other data were computed that were needed for the multiple correlations to be obtained. Just a dozen subjects were dealt with, these being the ones carried by the larger numbers of students during their last three years, and likewise during the freshman year. In other words, certain subjects commonly not begun until after the freshman year were not included in these computations. Since the highest simple coefficients for the various subjects are given in Table III, no separate table containing all of the simple coefficients will be included.

An inspection of those given in the first portion of this table shows that the simple correlations between marks during the last three years and the best single criteria tended to be slightly higher than the corresponding correlations for complete college marks as shown in the first portion of Table II. Indeed, none of the coefficients for the last three years were quite as large as two of those given in Table II. In all but three cases the coefficients in Table III were larger than those for the same subjects in Table II. Probably the most noteworthy increase was in the coefficient for the general college average. For the last three years' work the average correlated .69 with the best criterion, whereas for the complete college record the corresponding figure was only .54, a difference of .15. All of the subjects, biology, French, Latin, and Spanish, had simple coefficients with their best criteria of between .65 and .70, and corresponding coefficients of alienation of .75 or slightly less. The probable errors of estimate were in most cases four percentile points.

It will be seen that in every case except one, the criterion which gave the highest correlation with the marks made during the last three years was either the general freshman average or the freshman mark in the same subject. The one exception to this was zoology, which showed a higher correlation with point score than with any other criterion.

The multiple coefficients of correlation between marks during the last three years and the other data. The multiple coefficients of cor-

TABLE III. HIGHEST SIMPLE AND MULTIPLE COEFFICIENTS OF CORRELATION BETWEEN MARKS ABOVE FRESHMAN YEAR AND VARIOUS CRITERIA USED IN PREDICTING THEM

College Subject	Highest simple correlation with any one criterion				Highest multiple correlation with several criteria				Increase[a] of highest multiple over highest simple correlation		
	r	k	$P.E._{est}$	Criterion[b]	R	k	$P.E._{est}$	Criteria[b]	R-r	k	$P.E._{est}$
Accountancy	53	85	4	Fr. Acc.	56	83	4	Fr. Acc., H. S. Math., P.S.	.03	.02	0
Biology	69	72	3	Fr. Aver.	72	69	3	Fr. Aver., Fr. Biol.	.03	.03	0
Chemistry I[c]	62	.78	4	Fr. Aver.	66	75	3	Fr. Aver., H. S. Chem., P.S., Fr. Chem. or H. S. Aver.	.04	.03	1
Chemistry II	54	84	4	Fr. Aver.	57	82	4	Fr. Aver., Fr. Chem., H. S. Sci.	.03	.02	0
Economics	48	88	4	Fr. Aver.	49	87	4	Fr. Aver., H. S. Aver.	.01	.01	0
French	69	72	4	Fr. French	.70	.71	4	Fr. French, Fr. Aver.	.01	.01	0
German	51	86	4	Fr. Aver.	56	.83	4	Fr. Aver., Fr. Ger., P.S.	.05	.03	0
History	52	85	4	Fr. Hist.	.55	84	4	Fr. Hist., Fr. Aver., H. S. Aver. or H. S. Hist.	03	.01	0
Latin	.66	.75	3	Fr. Lat.	78	.63	2	Fr. Lat., Fr. Aver., H. S. For. L., P.S.	.12	12	1
Mathematics	53	85	5	Fr. Aver.	55	.84	5	Fr. Aver., Fr. Math., H. S. Math.	.02	.01	0
Rhetoric	.40	.92	3	Fr. Rhet.	.44	.90	3	Fr. Rhet., Fr. Aver., H. S. Eng.	04	02	0
Spanish	.68	73	4	Fr. Span.	.71	.70	4	Fr. Span., Fr. Aver., H. S. For. L.	03	03	0
Zoology	.40	.92	4	P.S.	.47	.88	4	P.S., Fr. Aver., Fr. Zool., H. S. Aver.	.07	.04	0
Average	.69	72	3	Fr. Aver.	.75	.66	3	Fr. Aver., H. S. Aver.	.06	.06	0

[a] The entries in the first column under this heading are actual increases in the coefficients of correlation and those in the other two, decreases in the coefficients of alienation and probable errors of estimate. In all cases, however, they indicate the increases in accuracy or reliability of prediction.

[b] The abbreviations in these columns are of the different high-school and college freshman subjects and groups of subjects, except "P.S.," which is used for point score. Those for the high-school subjects are preceded by "H.S.," and those for the freshman subjects by "Fr."

[c] Chemistry I includes only those freshmen who had carried chemistry in high school, whereas Chemistry II includes all who carried any science in high school.

relation presented in the second portion of Table III showed about the same increases over the simple correlations for the same data as were found in the case of complete college marks. Although none of the simple correlations in Table III were higher than the largest of those in Table II, yet one of the multiple correlations for the last three years, that for Latin, was greater than any corresponding one in Table II. Several others for the last three years, in addition to Latin, were also above .70, and, correspondingly, several of the coefficients of alienation were below .70. In only two or three cases, however, were the increases in accuracy great enough to result in an integral change in the probable errors of estimate.

Just as in the case of the simple correlations, so in the multiple ones the point score appears very rarely. Instead, high-school marks, in most cases those in particular subjects but in a few the general high-school average, ranked next to freshman average and freshman subject marks in worth as criteria. Indeed, except for the one subject of zoology, it appears that very little accuracy of prediction would have been lost if no intelligence test scores at all had been available.

Relationship between marks during the last three years of college and vocational choices and fathers' occupations. The relationship found to exist between the marks made during the last three years of college and vocational choices of the students and their fathers' occupations will not be presented in tabular form. It was, in general, distinctly lower than that found in the case of the complete college records and the criteria mentioned. There was a tendency for the same trends to appear, but none of them were marked enough to indicate conclusively that either vocational choices or fathers' occupations were valuable enough criteria of prediction to warrant their use.

Summary. The simple and multiple correlations between marks made during the last three years of college and those received during the high-school course and the freshman year of college were found to be somewhat higher than those between the complete college records and high-school marks alone. On the other hand, the coefficients between marks during the last three years and point scores were somewhat lower than were those in the case of complete college records and point scores. Likewise, the relationship of three-year marks with vocational choices and fathers' occupations was less than in the other case. Indeed, the statement is justified that only in a few cases did intelligence test scores, and in almost none at all, did vocational choices or fathers' occupations offer evidence of sufficiently predictive value to justify their use.

CHAPTER V

THE RELATIONSHIP BETWEEN PERSISTENCE IN COLLEGE AND VARIOUS OTHER DATA

The relationship between persistence in college and intelligence test scores. Table IV shows the relationship between persistence, that is, length of attendance in higher institutions, and intelligence test scores. In this and the succeeding tables that deal with length of attendance, students have been grouped according to the number of semesters they remained in college, and also according to whether they were dropped[1] or left voluntarily with or without graduation at the end of each. For example, all students who left at the end of one semester were divided into those who were dropped and those who left voluntarily. Similarly, those who left at the end of four semesters were divided into those who were dropped, those who quit voluntarily without completing a given course, and those who were graduated from a two-year course. Undoubtedly many of those who were not dropped but who did not continue were doing work of such poor quality as to be on probation or otherwise in danger of being dropped and, hence, did not return. No attempt, however, was made to separate these from the others who quit of their own will.

Similar to the results in other studies, the data from this investigation show a considerable relationship between the two items dealt with. This may be seen best by looking at the row of medians and that of per cents dropped at the bottom of the table. Although there are some irregularities, it will be seen that the median persistence or time attended had a tendency to increase along with the intelligence test score. Thus, for the groups that had scores of from twenty to twenty-four and twenty-five to twenty-nine, the lowest two that had more than ten cases, the median time attended was three semesters. For the next four higher groups it was four semesters, for the next four it was six, and finally, for the highest it was four-year graduation. Although the per cents of students dropped were somewhat more irregular, they still show the same general trend. Students who made test scores of sixty or above averaged more than one and one-half times as long in attendance as those whose scores were below fifty and had only about one-half as great a chance of being dropped.

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[1]The students reported as dropped include both those dropped because of poor scholarship and those dropped for disciplinary or other reasons. The former, however, constitute much the larger portion of the group.

TABLE IV.—RELATIONSHIP BETWEEN PERSISTENCE IN HIGHER INSTITUTIONS AND INTELLIGENCE TEST SCORE

Persistence	Intelligence Test Score															
	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	T	Median
4 yr. graduates		1		1	3	10	37	58	82	113	82	59	26	10	482	50.4
8 semesters					1	3	9	23	19	20	17	9	3	1	105	49.3
8 sem. dropped							1	1		1					3	(42.5)[a]
7 semesters					1		2	5	12	7	6	3			36	49.2
7 sem. dropped					1		1	2	1	3	1				9	(47.5)
3 yr. graduates						1	2		1	1	1			1	7	(47.5)
6 semesters			1	1	3	5	8	22	24	30	20	9	4	2	129	50.1
6 sem. dropped							3	2	2	1	5	1			14	50.0
5 semesters						3	2	10	12	6	4	3			40	47.1
5 sem. dropped					2	1	1	1		2	3	1			11	51.3
2 yr. graduates		1			3	9	12	25	16	15	12	3	2		98	44.8
4 semesters				3	6	13	20	36	58	42	20	12	6	1	217	47.6
4 sem. dropped						1	7	6	4	4	3	4	1		30	46.3
3 semesters				3	4	5	6	17	18	10	8	13	2		86	47.2
3 sem. dropped							4	4	6	3	5	1			23	47.9
2 semesters	1			2	6	16	40	62	62	49	31	17	12	3	301	46.9
2 sem. dropped			1		1	1	6	6	10	6	4	3	1		39	47.3
1 semester					3	10	13	19	29	18	8	7	2	2	111	45.4
1 sem. dropped				1	4	5	10	12	8	1	6	2			49	41.9
0 semesters					3	5	9	12	11	15	8	4	1		68	47.3
T	1	2	2	11	41	88	193	323	375	347	244	151	60	20	1858	48.6
Median	(2 sem.)	(3 yr.)	(4 sem.)	3 sem.	3 sem.	4 sem.	4 sem.	4 sem.	4 sem.	6 sem.	6 sem.	6 sem.	6 sem.	4 yr.	2 yr.	....
No. dropped	0	0	1	1	8	8	33	34	31	21	27	12	2	0	178	....
Per cent drop'd	(0)	(0)	(50)	9	20	9	17	11	8	6	11	8	3	0	9	....

[a]The medians and per cents dropped computed for groups of less than ten students are enclosed in parentheses.

The relationship between persistence in college and high-school averages. Table V is similar to Table IV, except that it deals with high-school averages rather than with point scores. From an inspection of Table IV and a comparison thereof with the last table, the relationship between high-school averages and persistence in college appears to be about the same as that between intelligence test scores and persistence. The medians given at the bottom of Table V show a fairly regular increase, except for a slight drop at the upper end. The per cents dropped decrease with somewhat greater regularity than the corresponding per cents in the case of intelligence test scores, although here also there is an irregularity at the upper end. It appears that students with high-school averages of ninety or better averaged about twice as long in college attendance as did those with similar averages below eighty. Furthermore, the chance of a student with a high-school average above ninety being dropped from college was only about one-tenth as great as that of a student whose high-school average was below eighty.

Relationship between persistence in college and vocational choice. Table VI shows the relationship found between the length of time students remained in attendance in college and their vocational choices. The degree of relationship shown is not so great as some similar studies have reported, but it appears to be slightly greater than that between college marks and vocational choices. From the table it will be seen that, although the average length of attendance of those included was only four semesters, there were several vocational groups including enough students to be fairly reliable that had averages of six semesters of attendance or more. With the exception of the farming group, all of these are what are commonly termed "professional." On the other hand, none of the groups, not even the one with no vocational choice, fell below the general average of four semesters.

Relationship between persistence in college and father's occupation. No table will be given to present the data showing the degree of relationship between persistence in college and fathers' occupations. The data suggested more or less the same relationships as were found between persistence and vocational choices, but they were on the whole less pronounced. The children of those engaged in philanthropic work were found to remain in college an average of seven semesters, and those whose fathers were engaged in clerical work, law, medicine, and publicity work, six semesters. None of the other groups showed any significant deviation from the average.

TABLE V.—RELATIONSHIP BETWEEN PERSISTENCE IN HIGHER INSTITUTIONS AND HIGH-SCHOOL AVERAGE

Persistence	High-School Average															
	70-71	72-73	74-75	76-77	78-79	80-81	82-83	84-85	86-87	88-89	90-91	92-93	94-95	96-97	T	Median
4 yr. graduates.		1	3	9	18	32	52	66	78	74	62	60	20	10	485	87.6
8 semesters....	1		1	8	14	13	12	18	13	10	8	4	6		108	84.6
8 sem. dropped.					1	1	1								3	(81.0)[a]
7 semesters....				2	5	2	4	9	3	3	3	4	1		36	85.1
7 sem. dropped.			2	1		1		1	2			2			9	(85.0)
3 yr. graduates.				3			2	2				1			8	(83.0)
6 semesters....			5	5	15	14	18	22	16	13	11	8	1	1	129	84.5
6 sem. dropped.				1	1	2	6	1	1	1			1		14	83.0
5 semesters....			2	2	1	9	3	12	1	4	3	1		2	40	84.5
5 sem. dropped.					3	1	3		3	1					11	83.0
2 yr. graduates.	1	1		4	15	12	18	11	11	9	7	6	3	1	99	83.8
4 semesters....		2	1	8	20	20	33	30	30	34	17	11	11	2	219	85.7
4 sem. dropped.			1	2	6	4	8	4	2	2		1		1	31	82.6
3 semesters....		2	5	4	9	12	10	8	10	11	7	5	4		87	84.4
3 sem. dropped.			2	2	1	7	7	4							23	81.9
2 semesters....		4	9	19	32	37	43	39	46	29	23	13	4	4	302	84.3
2 sem. dropped.		1	1	5	7	8	6	4	6	1					39	81.4
1 semester.....			4	6	13	17	18	17	9	10	8	6	2	1	111	83.7
1 sem. dropped.		1	5	7	9	10	9	6	1	1		1			50	80.6
0 semesters....	1	1	2	9	16	11	7	5	9	3	3	1	1		69	81.0
T.....	3	13	43	97	186	213	260	259	241	206	15 2	124	54	22	1873	84.9
Median.....	(2 yr.)	2 sem.	3 sem. drop.	3 sem.	4 sem.	4 sem.	4 sem.	5 sem.	2 yr.	5 sem.	6 sem.	8 sem.	7 sem.	6 sem. drop.	2 yr.	....
No. dropped...	0	2	11	18	28	34	40	20	15	6	0	4	1	1	180	....
Per cent drop'd	(0)	15	26	19	15	16	15	8	6	3	0	3	2	5	10	....

[a]The medians and per cents dropped computed for groups of less than ten students are enclosed in parentheses.

TABLE VI.—RELATIONSHIP BETWEEN PERSISTENCE IN HIGHER INSTITUTIONS AND VOCATIONAL CHOICE

Persistence	Vocational Choice																
	Clerical	Engineering	Farming	Law	Medicine	Philanthropy	Public Entertainment	Publicity	Skilled Manufacturing	Transportation	Teaching	Trade	Miscellaneous Professions	Miscellaneous	Total Choices	No Choice	Grand Total
4 yr. graduates	5	38	11	13	22	9	12	12	5	1	137	19	14		298	182	480
8 semesters		14	3	7	5	1			3	1	11	5			50	42	92
8 sem. dropped											1				1	2	3
7 semesters		3	3	3	2	2	1			1	5	3			23	13	36
7 sem. dropped		2						1	1		2				6	3	9
3 yr. graduates		1			1						2				4	4	8
6 semesters	4	12	2	5	6	2	2	3	2	2	25	7	3	2	77	43	120
6 sem. dropped		1	1		2			1			2	1			8	4	12
5 semesters		2			2						7	5	1	1	18	19	37
5 sem. dropped		3			3										6	5	11
2 yr. graduates	2	2	1		1	1		1			51	10	3	1	73	25	98
4 semesters	7	14	1	7	7	1	5	3	1		67	15	2	1	131	81	212
4 sem. dropped	2	6		2	2			1	3	1	2		1	1	21	9	30
3 semesters	3	7	1		3				1		27	5	2		49	33	82
3 sem. dropped		4	1	2	2						3	4			16	6	22
2 semesters	6	20	8	7	13		5	6	3		98	13	8	1	188	108	296
2 sem. dropped	1	5	1	3	3				1			4		1	19	17	36
1 semester	4	11		3	2	1	1	1			28	5	3	2	61	48	109
1 sem. dropped		6		2	4	1	1	1	2		4	4	4		29	21	50
0 semesters	3	10	1	1	3				2		7	11	1		39	29	68
Total	37	161	34	55	83	18	27	30	24	6	479	111	42	10	1117	694	1811
Median	4 sem. drop.	6 sem. drop.	6 sem.	6 sem.	5 sem. drop.	8 sem.	6 sem.	6 sem.	4 sem. drop.	(7 sem. drop.)	4 sem.	2 yr.	2 yr.	4 sem.	4 sem.	4 sem.	4 sem.
No. dropped	3	27	3	9	16	1	1	4	7	1	14	13	5	2	106	67	173
Per cent dropped	8	17	9	16	19	6	4	13	29	(17)[a]	3	12	12	20	10	10	10

[a]The medians and per cents dropped computed for groups of less than ten students are enclosed in parentheses.

TABLE VII.—RELATIONSHIP BETWEEN PERSISTENCE IN HIGHER INSTITUTIONS AND FRESHMAN AVERAGE

Persistence	Freshman Average									
	Less than 65	65-69	70-74	75-79	80-84	85-89	90-94	95-99	T	Median
4 yr. graduates			1	25	160	198	92	10	486	86.4
8 semesters		4	1	26	33	30	12	1	107	83.4
8 sem. dropped					2	1			3	(83.8)[a]
7 semesters				4	17	14	1		36	84.1
7 sem. dropped			1	3	4	1			9	(80.6)
3 yr. graduates				4	2	1	1		8	(80.0)
6 semesters			5	22	49	35	23	1	135	84.1
6 sem. dropped			1	2	9	1		1	14	82.2
5 semesters			7	7	11	8	6	1	40	82.7
5 sem. dropped			3	6	2				11	77.1
2 yr. graduates			5	17	36	30	11	1	100	83.9
4 semesters		2	10	41	83	58	24	2	220	83.4
4 sem. dropped		2	5	11	8	5			31	78.9
3 semesters			13	23	28	20	3		87	81.3
3 sem. dropped		1	7	14	1				23	76.3
2 semesters	1	7	32	49	104	51	23	2	269	82.2
2 sem. dropped	1	18	13	8	1				41	70.6
1 semester	1	3	19	35	28	15	6	4	111	79.6
1 sem. dropped	17	18	9	6					50	67.2
T	20	55	132	303	578	468	202	23	1781	83.3
Median	1 sem. drop.	2 sem. drop.	2 sem.	4 sem.	5 sem. drop.	7 sem.	8 sem.	6 sem.	2 yr.	....
No. dropped	18	39	39	50	27	8	0	1	182	....
Per cent dropped	90	70	30	20	5	2	0	4	10	....

[a]The medians computed for groups of less than ten students are enclosed in parentheses.

Relationship between persistence in college and freshman college average. Table VII is similar to Table V, except that it deals with freshman college averages rather than high-school averages. As most readers would probably expect, it shows that there was a closer relationship between freshman averages and length of college attendance than existed in the case of any of the other data presented in this chapter and the latter. The median length of attendance rose very sharply from the group having the lowest freshman average to that with the next to the highest. The very highest group, which was quite small, had a somewhat smaller average length of attendance. Those in the lowest freshman average group, the one with marks below sixty-five, were practically all dropped the first semester, and almost all of those in the next group, from sixty-five to sixty-nine, were dropped by the end of the second semester, whereas the median attendance for the group whose averages were ninety to ninety-four was eight semesters. In the case of per cents dropped the differences were perhaps even more striking. Ninety per cent of the lowest group and 70 per cent of the next to the lowest group were dropped, whereas only 2 per cent of the group with averages from eighty-five to eighty-nine, and none of the group with averages from ninety to ninety-four, were dropped. It appears that if a student had a freshman average of eighty-five or above, he had only about one chance in eighty of being dropped at any time, whereas if his average was below seventy, there were about three chances out of four that he would be dropped, if it was below seventy-five, almost one chance in two, and if below eighty, almost one in three.

Summary. From the data obtained in this study it appears that there is a definite positive relationship between the lengths of time students remain in attendance in college and their intelligence test scores, their high-school averages, their vocational choices, and their freshman averages. The relationship is the closest in the case of freshman averages. There is also some relationship between persistence and father's occupation, but it is scarcely enough to justify using the latter as a basis of prediction. If a student is in the upper quarter or even the upper third of both intelligence test scores and high-school averages, it is very unlikely that he will be dropped from college, whereas if he is in the lower quarter or third of both, his chances of being dropped are fairly large, and the chances are at least eight or ten to one that he will not remain in college much, if any, longer than two years. If both freshman average and intelligence test score are high or low, the corresponding chances are much larger, indeed, almost double.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The problem. The problem of this investigation has been to determine how accurately the marks and length of attendance of college students can be predicted from certain data available when they enter college and also how accurately those for the last three years of college can be predicted from data available at the end of the freshman year.

The prediction of college marks from data available at entrance. The simple correlations between college marks in fifty-five subjects or groups of subjects and high-school marks and intelligence test scores were found. Very few of the coefficients were above .50, the majority of those with high-school marks ranging from .30 to .50, and of those with point scores from .20 to .40. The corresponding coefficients of alienation, which measure the guessing element, were in no instance less than .70, and in most cases between .80 and .90. The multiple coefficients of correlation for a number of the same subjects were in general only a comparatively few points larger than the highest simple coefficients for the same subjects. About one-fourth of the multiple coefficients were .60 or above, but the majority of them fell between .40 and .60. A very few of the corresponding coefficients of alienation were around .70, but most of them fell between .80 and .90. The probable errors of estimate were generally four or five percentile points. Students' vocational choices appeared to have a little significance in indicating their college marks, and their fathers' occupations very little, if any.

The prediction of marks in the upper three years of college. For those subjects carried by a fairly large number of students in the last three years of college, the simple and multiple correlations with data available at the end of the freshman year were found. On the whole, these correlations tended to be only slightly higher than those of the complete college marks with the data available at entrance.

The prediction of persistence in college. Persistence or length of attendance in college appeared to have a decided relationship with students' intelligence test scores and an even higher degree of relationship with their high-school averages. That with vocational choices was somewhat stronger than in the case of college marks and vocational choices, and the same was true with regard to fathers' occupa-

tions. For the last three years of college, persistence had a decidedly close relationship with freshman average.

Conclusion as to the accuracy of predicting college success. Although, as has been shown previously, the criteria employed in this study did not yield highly accurate predictions of success in college as measured by marks received and length of attendance, yet they exhibited some relationship therewith. In other words, if, as is true in many situations, some selection is to take place, these data offer a distinctly better basis than does mere chance for the selection of those students who will profit most by college attendance. Moreover, other studies have shown that by the use of a longer and more reliable intelligence test, such, for example, as Thorndike's Intelligence Examination for High-School Graduates, of the best types of entrance examinations or standardized tests covering work carried in high school, of ratings of study habits and other factors that contribute to success, the reliability of prediction can be increased considerably above that obtained in this study. By the combination of these means, it is probable that under favorable circumstances an institution of higher learning can obtain multiple coefficients of correlation of at least .75 or .80 for many of the subjects carried therein, and of above .80 for the general college average. Thus, for the latter it is probable that the coefficient of alienation, or guessing element, can be reduced to about one-half, and in some cases even somewhat below this.

APPENDIX A

THE RELATIONSHIP BETWEEN SIZE OF HIGH SCHOOL ATTENDED AND COLLEGE SUCCESS

From time to time there has been considerable discussion as to whether students who have had their high-school training in schools of different sizes show any consistent and significant differences in level of achievement and ability to do college work. In view of this fact it seemed worth while as a sort of by-product of this investigation to tabulate the available data so that they might, if possible, throw some light upon this question. For this purpose Tables VIII and IX are presented. The first shows the relationship between size of high school attended and college averages, and the second, that between size of high school and persistence in college. In constructing each, the high schools attended by the students included were classified into five groups on the basis of their size at the time the students were seniors in them, that is, in the school year 1923-24. As will be seen from both tables, there is some tendency for the students coming from the smallest group of high schools, that is, those with less than one hundred students, to be slightly below average. Their average college mark was only eighty-two as compared with eighty-three for all students, and their average length of attendance only three semesters, one less than the average for all. Also in the case of those coming from high schools of from 500 to 999, inclusive, a similar tendency is shown in both tables, since their average mark was eighty-four and their average attendance six semesters. In the cases of the other three groups according to size, no consistent departure from the general average appears. The apparent conclusion regarding the matter is, therefore, that on the whole there is little relationship between size of high school attended and college success as measured either by marks received or length of attendance. Students from the very smallest high schools are probably at a slight disadvantage, whereas those from high schools of from 500 up to 1000 students seem to have a very small advantage.

TABLE VIII.—RELATIONSHIP BETWEEN COLLEGE AVERAGE AND SIZE OF HIGH SCHOOL ATTENDED

College Average	Size of High School					
	1-99	100-299	300-499	500-999	1000 or more	Total
95-99	1	5	3	5	4	18
90-94	15	56	24	32	49	176
85-89	78	139	77	97	66	457
80-84	88	138	79	85	148	538
75-79	65	91	38	48	95	337
70-74	23	25	14	13	30	105
65-69	10	10	6	9	14	49
60-64	7	5	2	2	3	19
55-59			1			1
50-54		1		1		2
Total	287	470	244	292	409	1702
Median	82	84	84	84	82	83

TABLE IX.—RELATIONSHIP BETWEEN PERSISTENCE IN COLLEGE AND SIZE OF HIGH SCHOOL ATTENDED

Length of Attendance	Size of High School					
	1-99	100-299	300-499	500-999	1000 or more	Total
4 yr. graduates	58	128	58	104	137	485
8 semesters	13	27	11	17	40	108
8 sem. dropped	0	0	1	1	1	3
7 semesters	7	8	8	4	6	33
7 sem. dropped	2	3	2	2	2	11
3 yr. graduates	0	0	1	4	3	8
6 semesters	16	37	23	28	31	135
6 sem. dropped	1	6	1	1	5	14
5 semesters	5	7	7	10	11	40
5 sem. dropped	1	4	0	4	1	10
2 yr. graduates	16	29	8	6	33	92
4 semesters	21	26	9	12	17	85
4 sem. dropped	16	29	15	14	18	92
3 semesters	35	37	23	23	43	161
3 sem. dropped	2	2	5	3	8	20
2 semesters	70	101	34	37	59	301
2 sem. dropped	5	7	3	6	18	39
1 semester	23	30	9	16	32	110
1 sem. dropped	10	12	9	5	14	50
0 semesters	14	19	4	13	19	69
Total	315	512	231	310	498	1866
Median	3 sem.	4 sem.	2 yr. grad.	6 sem.	2 yr. grad.	2 yr. grad.

APPENDIX B

NUMBERS OF SEMESTER HOURS OF DIFFERENT SUBJECTS AND GROUPS OF SUBJECTS CARRIED BY FOUR-YEAR STUDENTS

Although the matter dealt with in this appendix had no integral connection with the chief purpose of this study, it seemed to the writer that the presentation of figures showing how many semester hours of different subjects and groups of subjects were carried by students who completed four-year college courses might be of interest to many readers. For this reason Table X, which shows this for all subjects or groups of subjects carried by twenty-five or more four-year college students,[1] is presented. In it figures are given that show how many students carried a total of from one to nine, ten to nineteen, twenty to twenty-nine, and so on, hours in each subject or subject group, and also the total number carrying each subject. As would be expected, the largest number of students carried some work in English,[2] almost 90 per cent having done so. Physical education is a close second, since about 85 per cent took work in that subject. There is a distinct drop to the next subjects, which are education and mathematics, with less than 70 per cent of all students in each. The only subject in which any student carried as much as eighty hours or more was music, in which nine individuals did so, and the only others in which anyone carried as many as sixty hours were art and design, chemistry, English, and law, with no more than six doing so in any one of them. In most subjects the majority of students carried less than ten hours of work, although in several, more carried from ten to nineteen hours, inclusive, than any other number. In none did the hours carried by the most students rise above this.

[1]The expression "four-year students" is used to include all those who remained in school four years, that is, those included under the headings "four-year graduates," "eight semesters," and "eight semesters dropped" in previous tables.

[2]The English column in the table includes rhetoric, although the latter is given separately also, and all other work commonly classified under that general name.

TABLE X.—NUMBER OF SEMESTER HOURS OF DIFFERENT SUBJECTS AND GROUPS OF SUBJECTS CARRIED BY FOUR-YEAR STUDENTS[a]

Number of Hours	Accountancy	Art and Design	Astronomy	Bacteriology	Bible	Biology	Botany	Business Organization and Operation	Business Law	Chemistry	Civics	Economics	Education	Electrical Engineering	English	French	General Engineering Drawing	Geography	Geology	German	Greek	History	Home Economics
1–9	64	90	43	65	176	96	89	32	58	156	23	214	129	24	212	99	66	34	130	50	32	166	50
10–19	24	8		4	14	33	20	32	2	146	2	64	224	4	175	137	6	18	18	68	12	121	4
20–29	8	3		1	2	6	4	1		42		40	51	3	74	39	1	1	2	3	5	46	5
30–39	8				1	3	4	1		16		17	3	6	47	18			6	1		25	9
40–49						1	1			10		4		4	18	1			1			1	9
50–59							1			3		1			2								1
60–69		1								3			1		1								
70–79		3								3					1								
80–89																							
90–99																							
100–109																							
Total	104	105	43	70	193	139	119	66	60	379	25	340	408	41	530	294	73	53	157	122	49	359	78
Per cent[b]	17	18	7	12	32	23	20	11	10	64	4	57	68	7	89	49	12	9	26	20	8	60	13

TABLE X.—*(Concluded)*

Number of Hours	Hygiene	Latin	Law	Library Science	Mathematics	Mechanical Engineering	Military Science	Music	Orientation	Philosophy	Physical Education	Physics	Physiology	Political Science	Psychology	Public Speaking	Religious Education	Rhetoric	Sociology	Spanish	Theoretical and Applied Mechanics	Transportation	Zoology
1–9	194	61	14	27	211	24	122	99	28	223	462	108	88	157	359	222	66	325	267	106	16	28	104
10–19		21	4		108	18	23	9	13	29	36	86	11	33	20	29	6	19	32	106	35		23
20–29		12	9		72	9	1	3		3	3	8		11	3	7			6	26			9
30–39		10	3		12	2		4		2				2	1	1	1		3	3			1
40–49		1	3		1	1					3					1			1	2			
50–59			3			2		2															
60–69			4																				
70–79			1					1															
80–89								2															
90–99								5															
100–109								2															
Total	194	105	41	27	404	56	146	127	41	257	504	202	99	203	383	260	73	344	309	243	51	28	137
Per cent[b]	33	18	7	5	68	9	24	21	7	43	85	34	17	34	64	44	12	58	52	41	9	5	23

[a]All subjects or groups of subjects carried by twenty-five or more four-year students are included in this table. The following subjects were carried by less than twenty-five students apiece: Agriculture, Agronomy, Anatomy, Animal Husbandry, Anthropology, Architecture, Arithmetic, Athletic Coaching, Chemical Engineering, Civil Engineering, Commerce, Dentistry, Dramatic Art, Drawing, Engineering, Entomology, Horticulture, Italian, Journalism, Kindergarten, Manual Arts, Medicine, Pharmacy, Scandinavian.

[b]The total number of students upon which these per cents were figured was 596.